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Epitome

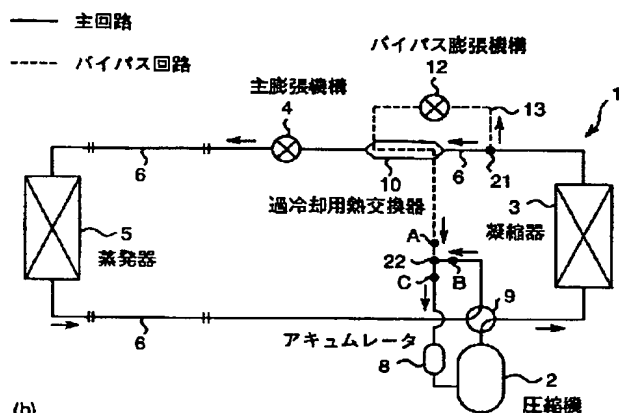
(57) [Abstract]

[Technical problem] The air conditioner which can improve refrigerating capacity conventionally is offered.

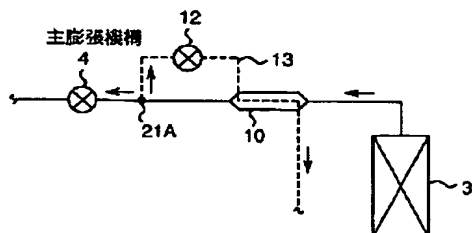
[Means for Solution] It has the refrigerant circuit 1 where a refrigerant flows in order of a compressor 2, a condenser 3, the heat exchanger 10 for supercooling, the 1st expansion device 4, and an evaporator 5. A non-azeotropy mixing refrigerant is used as a refrigerant. A refrigerant circuit 1 has the 2nd expansion device 12 in this bypass circuit 13 while being equipped with the bypass circuit 13 which branches from a main circuit 6 between a condenser 3 and the 1st expansion device 4, and joins a main circuit 6 by the inlet side of a compressor 2. The heat exchanger 10 for supercooling performs heat exchange between the mainstream refrigerant which flows a main circuit 6, and the bypass style refrigerant which flows the bypass circuit 13 after the 2nd expansion device 12 passage. The heat exchanger 10 for supercooling is a counterflow mold heat exchanger to which the above-mentioned mainstream refrigerant and the above-mentioned bypass style refrigerant flow to the opposite sense mutually on both sides of wall 10a with heat-conducting characteristic.

[Translation done.]

(a)



(b)



[Translation done.]

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CLAIMS

[Claim(s)]

[Claim 1] In the air conditioner equipped with the refrigerant circuit (1) where a refrigerant flows in order of a compressor (2), a condenser (3), the heat exchanger for supercooling (10), the 1st expansion device (4), and an evaporator (5) A non-azeotropy mixing refrigerant is used as the above-mentioned refrigerant. The above-mentioned refrigerant circuit (1) While having the bypass circuit (13) which branches from a main circuit (6) between the above-mentioned condenser (3) and the 1st expansion device (4), and joins the above-mentioned main circuit (6) by the inlet side of the above-mentioned compressor (2) It has the 2nd expansion device (12) in this bypass circuit (13). The above-mentioned heat exchanger for supercooling (10) Heat exchange is performed between the mainstream refrigerant which flows the above-mentioned main circuit (6), and the bypass style refrigerant which flows the above-mentioned bypass circuit after expansion device (12) passage of the above 2nd (13). The above-mentioned heat exchanger for supercooling (10) is an air conditioner characterized by being the counterflow mold heat exchanger to which the above-mentioned mainstream refrigerant and the above-mentioned bypass style refrigerant flow to the opposite sense mutually on both sides of a wall (10a) with heat-conducting characteristic.

[Claim 2] It is the air conditioner characterized by the above-mentioned bypass circuit (13) having branched from the above-mentioned main circuit (6) between the above-mentioned condenser (3) and the heat exchanger for supercooling (10) in an air conditioner according to claim 1.

[Claim 3] It is the air conditioner characterized by the above-mentioned bypass circuit (13) having branched from the above-mentioned main circuit (6) in an air conditioner according to claim 1 between the above-mentioned heat exchanger for supercooling (10), and the 1st expansion device (4).

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to an air conditioner. It is related with the air conditioner equipped with the refrigerant circuit which circulates a refrigerant in more detail in order of a compressor, a condenser, the heat exchanger for supercooling that supercools a refrigerant, an expansion device, and an evaporator.

[0002]

[Description of the Prior Art] As shown in drawing 10, as a refrigerant circuit 1 of this kind of air conditioner. The main circuit 306 which has a compressor 302, a condenser 303, the double pipe exchanger 310 for supercooling, the main expansion device 304, an evaporator 305, the 4 way change-over valve 309, and an accumulator 308 in this order. It branches from a main circuit 306 at the branch point 321 between the above-mentioned condenser 303 and a double pipe exchanger 310. It passes along the bypass expansion device 312 and a double pipe exchanger 310, and the thing including the bypass circuit (a broken line shows) 313 which joins a main circuit 306 in the juncture 322 near the inlet port of the above-mentioned accumulator 308 is known. Conventionally, the single refrigerant of HCFC(hydrochlorofluorocarbon)22 grade is used as a refrigerant. The refrigerant breathed out from the compressor 302 is condensed by the condenser (for example, heat is radiated to outdoor air) 303, and separates to the mainstream refrigerant which flows a main circuit 306 at a junction 321, and the bypass style refrigerant which flows the bypass circuit 313. In a double pipe exchanger 310, after this mainstream refrigerant is supercooled by heat exchange with the above-mentioned bypass style refrigerant after bypass expansion device 312 passage, it is decompressed by the main expansion device 304. And a mainstream refrigerant evaporates with an evaporator (for example, it carries out endoergic from indoor air) 305, and is absorbed by the compressor 302 through the accumulator 308 which performs the 4 way change-over valve 309 and vapor liquid separation. On the other hand, after a bypass style refrigerant passes the above-mentioned bypass expansion device 312 and is decompressed, it evaporates by heat exchange with a mainstream refrigerant in a double pipe exchanger 310. Then, a bypass style refrigerant joins a mainstream refrigerant in the juncture 322 near the inlet port of an accumulator 308.

[0003] Thus, by supercooling a mainstream refrigerant by the double pipe exchanger 310, the refrigerating effect by the mainstream refrigerant can be increased as compared with the case where supercooling is not performed. Moreover, since the volumetric flow rate of a mainstream refrigerant decreases by branching a bypass style from the flow of a refrigerant, as shown in the pressure-specific-enthalpy diagram (henceforth "Ph diagram") of drawing 11 (b), pressure loss ΔP in the inside of an evaporator 305 and inlet-side piping of a compressor 302 can be decreased (since it is a comparison, the pressure loss ΔP_0 when not performing supercooling is shown in drawing 11 (a)). Therefore, the refrigerating capacity of a system can be raised. In addition, the part shown by A, B, and C in drawing 11 (b) supports the condition of the about 322 juncture [in the refrigerant circuit 301 of drawing 10] points A, B, and C. The bypass style refrigerant which reached Point A, and the mainstream refrigerant which reached Point B join, and the condition of Point C is acquired so that drawing 11 (c) which expands drawing 11 (b) partially and shows it may show well. [0004]

[Problem(s) to be Solved by the Invention] By the way, always raising the refrigerating capacity of an air conditioner is called for, and there are no limits in the demand of a refrigerating capacity rise.

[0005] Then, the purpose of this invention is to offer the air conditioner which can raise refrigerating capacity further rather than before.

[0006]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, an air conditioner according to claim 1. In the air conditioner equipped with the refrigerant circuit where a refrigerant flows in order of a compressor, a condenser, the heat exchanger for supercooling, the 1st expansion device, and an evaporator. A non-azeotropy mixing refrigerant is used as the above-mentioned refrigerant. The above-mentioned refrigerant circuit. While having the bypass circuit which branches from a main circuit between the above-mentioned condenser and the 1st expansion device, and joins the above-mentioned main circuit by the inlet side of the above-mentioned compressor. It has the 2nd expansion device in this bypass circuit. The above-mentioned heat exchanger for supercooling. Heat exchange is performed between the mainstream refrigerant which flows the above-mentioned main circuit, and the bypass style refrigerant which flows the above-mentioned bypass circuit after expansion device passage of the above 2nd. The above-mentioned heat exchanger for supercooling. It is characterized by being the counterflow mold heat exchanger to which the above-mentioned mainstream refrigerant and the above-mentioned bypass style refrigerant flow to the opposite sense mutually on both sides of a wall with heat-conducting characteristic.

[0007] It sets in Ph diagram which expresses the condition of a refrigerant with the air conditioner of this claim 1 since the boiling points of the refrigerant which constitutes a non-azeotropy mixing refrigerant differ mutually, and is inclination (inclination to a specific-enthalpy shaft.) to the constant-temperature line in a two phase region (wet steam range). It is called a "temperature gradient" below. It is generated. For the temperature gradient of this two phase region, the inlet temperature of an evaporator falls as compared with the case where a single refrigerant is used. Therefore, with an evaporator, the temperature gradient between the fluid (for example, indoor air) by which endoergic is carried out, and the above-mentioned refrigerant passing through the inside of the evaporator becomes large, and the heat exchange capacity of an evaporator

increases. Consequently, the refrigerating capacity improvement effect by supercooling improves further by heat exchange capacity increase of the above-mentioned evaporator as compared with the case where a single refrigerant is used.

[0008] Moreover, in this air conditioner, using the bypass style refrigerant after expansion device passage of the above 2nd, a mainstream refrigerant can be supercooled as easy circuitry is also.

[0009] Furthermore, in this air conditioner, since the above-mentioned heat exchanger for supercooling is a counterflow mold heat exchanger, the mean temperature difference between the mainstream refrigerants and bypass style refrigerants which are a non-azeotropy refrigerant in the both sides of a wall with the heat-conducting characteristic of the heat exchanger for supercooling becomes comparatively large. For example, it becomes larger than the mean temperature difference in the case of a parallel-current-flow mold heat exchanger. Consequently, the capacity of the heat exchanger for supercooling improves.

[0010] An air conditioner according to claim 2 is characterized by the above-mentioned bypass circuit having branched from the above-mentioned main circuit between the above-mentioned condenser and the heat exchanger for supercooling in an air conditioner according to claim 1.

[0011] Since the object supercooled by the heat exchanger for supercooling serves as only a mainstream refrigerant, the size of the heat exchanger for supercooling is comparatively small, and can be managed with the air conditioner of this claim 2.

[0012] An air conditioner according to claim 3 is characterized by the above-mentioned bypass circuit having branched from the above-mentioned main circuit between the above-mentioned heat exchanger for supercooling, and the 1st expansion device in an air conditioner according to claim 1.

[0013] In the air conditioner of this claim 3, since the bypass style refrigerant which branched from the mainstream refrigerant after the heat-exchanger passage for supercooling goes into the 2nd expansion device, possibility that two-phases flow will enter decreases in the 2nd expansion device. Therefore, the 2nd expansion device does not have a possibility of causing hunting, and operates to stability.

[0014]

[Embodiment of the Invention] Hereafter, the gestalt of implementation of this invention is explained to a detail.

[0015] (The 1st operation gestalt) As shown in drawing 1 (a), the air conditioner of 1 operation gestalt of this invention is equipped with the refrigerant circuit 1 including a main circuit 6 and the bypass circuit (a broken line shows) 13. As a refrigerant made to circulate through a refrigerant circuit 1, the non-azeotropy mixing refrigerant which consists of R-32/134a or R-407C is used.

[0016] The main circuit 6 has the main expansion device 4, the evaporator 5, the 4 way change-over valve 9, and accumulator 8 as a compressor 2, a condenser 3, the double pipe exchanger 10 as a heat exchanger for supercooling, and 1st expansion device in this order. The bypass circuit 13 branches from a main circuit 6 at the junction 21 between a condenser 3 and a double pipe exchanger 10, passes along the bypass expansion device 12 and double pipe exchanger 10 as 2nd expansion device, and joins the main circuit 6 in the juncture 22 near the inlet port of an accumulator 8. A double pipe exchanger 10 performs heat exchange between the mainstream refrigerant which flows a main circuit 6, and the bypass style refrigerant which flows the above-mentioned bypass circuit 13 after bypass expansion device 12 passage. That is, using the bypass style refrigerant after bypass expansion device 12 passage, a mainstream refrigerant is supercooled as easy circuitry is also. In detail, the double pipe exchanger 10 has inner-tube 10a and outer-tube 10b prepared in the outside of this inner-tube 10a in the shape of a concentric circle, as typically shown in drawing 4 (a). The sense which pours a refrigerant is set up so that the mainstream refrigerant which flows annular clearance 10c between the bypass style refrigerant which flows the inside of inner-tube 10a, and inner-tube 10a and outer-tube 10b may flow to the opposite sense mutually on both sides of the tube wall with heat-conducting characteristic of inner-tube 10a (counterflow mold heat exchanger). Thus, when a heat exchanger 10 is used as a counterflow mold, as shown in drawing 4 (b), the mean temperature difference about the flow direction between the mainstream refrigerants and bypass style refrigerants with heat-conducting characteristic in the both sides of the tube wall of inner-tube 10a becomes comparatively large. For example, it becomes larger than the mean temperature difference in the case of the parallel-current-flow mold heat exchanger shown in drawing 4 (c). Consequently, the capacity of a heat exchanger 10 can be raised.

[0017] Now, the refrigerant breathed out from the compressor 2 shown in drawing 1 (a) is condensed by the condenser (for example, heat is radiated to outdoor air) 3, and separates to the mainstream refrigerant which flows a main circuit 6 at a junction 21, and the bypass style refrigerant which flows the bypass circuit 13. In a heat exchanger 10, after this mainstream refrigerant is supercooled by heat exchange with the above-mentioned bypass style refrigerant after bypass expansion device 12 passage, it is decompressed by the main expansion device 4. And a mainstream refrigerant evaporates with an evaporator (for example, it carries out

endoergic from indoor air) 5, and is absorbed by the compressor 2 through the accumulator 8 which performs the 4 way change-over valve 9 and for liquid separation. On the other hand, after a bypass style refrigerant passes the bypass expansion device 12 and is decompressed, it evaporates by heat exchange with a mainstream refrigerant in a heat exchanger 10. Then, a bypass style refrigerant joins a mainstream refrigerant in the juncture 22 near the inlet port of an accumulator 8.

[0018] Thus, by supercooling a mainstream refrigerant by the heat exchanger 10, the refrigerating effect by the mainstream refrigerant can be increased as compared with the case where supercooling is not performed. Moreover, as compared with the case (refer to drawing 11 (a)) where supercooling is not performed, since the volumetric flow rate of a mainstream refrigerant decreases by branching a bypass style from the flow of a refrigerant, as shown in the pressure-specific-enthalpy diagram (henceforth "Ph diagram") of drawing 2, pressure loss ΔP in the inside of an evaporator 5 and inlet-side piping of a compressor 2 can be decreased. Therefore, the refrigerating capacity of a system can be raised. In addition, the part shown by A, B, and C in drawing 2 supports the condition of the about 22 juncture [in the refrigerant circuit 1 of drawing 1 (a)] points A, B, and C.

[0019] And it sets in Ph diagram shown in drawing 2 since the boiling points of the refrigerant which constitutes the non-azeotropy mixing refrigerant which flows a refrigerant circuit 1 differ mutually, and is inclination (inclination to a specific-enthalpy shaft.) to the constant-temperature line in a two phase region (wet steam range). It is called a "temperature gradient" below. It is generated. For the temperature gradient of this two phase region, the inlet temperature of an evaporator 5 falls as compared with the case where a single refrigerant is used. Therefore, with an evaporator 5, the temperature gradient between the fluid (for example, indoor air along which it passes in contact with the fin of an evaporator) by which endoergic is carried out, and the refrigerant passing through the inside of the evaporator 5 becomes large, and the heat exchange capacity of an evaporator 5 increases. For example, if the inlet temperature of an evaporator 5 falls only in 2 deg as shown in drawing 3, the heat exchange capacity of an evaporator 5 will increase about 15%. Consequently, the refrigerating capacity improvement effect by supercooling can be further raised by heat exchange capacity increase of an evaporator 5 as compared with the case where a single refrigerant is used.

[0020] Moreover, since the bypass circuit 13 has branched from a main circuit 6 between a condenser 3 and a heat exchanger 10 as shown in drawing 1 (a), the object supercooled by the heat exchanger 10 serves as only a mainstream refrigerant. Therefore, size of a heat exchanger 10 can be made comparatively small.

[0021] In addition, you may make it the bypass circuit 13 branch from a main circuit 6 between a heat exchanger 10 and the main expansion device 4 (branch point 21A), as shown in drawing 1 (b). Since the bypass style refrigerant which branched from the mainstream refrigerant after passing a heat exchanger 10 goes into the bypass expansion device 12 when it does in this way, possibility that two-phases flow will enter decreases in the bypass expansion device 12. Therefore, the bypass expansion device 12 does not have a possibility of causing hunting, and operates to stability.

[0022] As mentioned above, the heat exchanger 10 is performing heat exchange between the mainstream refrigerant which flows the main circuit 6 in the condition of having been condensed by the condenser 3, and the bypass style refrigerant after bypass expansion device 12 passage. That is, fundamentally, the heat exchanger 10 is operating as a liquid-solution temperature exchanger which performs heat exchange between the mainstream refrigerant after condenser 3 passage and before evaporator 5 passage, and a bypass style refrigerant. On the other hand, as shown in drawing 5, in order to supercool the mainstream refrigerant after condenser 5 passage, the mainstream refrigerant of the gaseous phase after evaporator 5 passage (compressor inlet side) may be used, and a heat exchanger 10 may be operated as a mind-solution temperature exchanger. However, when operating the heat exchanger 10 as shown in drawing 1 as a liquid-solution temperature exchanger, as shown in Ph diagram of drawing 7 (a), it originates in the temperature gradient in a two phase region, and mean temperature difference ΔT_m about the flow direction in a heat exchanger 10 becomes larger than ΔT_m in the case of making it operate as a mind-solution temperature exchanger (shown in drawing 7 (b)). Therefore, size of a heat exchanger 10 can be made comparatively small, and fault (refer to drawing 6) to which the degree of superheat of the inlet side of a compressor 2 becomes large does not arise. Consequently, the refrigerating capacity improvement effect by using a non-azeotropy mixing refrigerant can be demonstrated more effectively.

[0023] (The 2nd operation gestalt) Drawing 8 shows the air conditioner of another operation gestalt equipped with the refrigerant circuit 101 which supercools a refrigerant using the cold energy stored in ice. This refrigerant circuit 101 is equipped with the refrigerant circuit 101 including a main circuit 106 and a short circuit 113. As a refrigerant made to circulate through a refrigerant circuit 101, the non-azeotropy mixing refrigerant which consists of R-32/134a or R-407C is used.

[0024] The main circuit 106 has the receiver 107 for storing a compressor 102, the outdoor heat exchanger

103 as a condenser, and a refrigerant temporarily, the 2nd electronic expansion valve 112, the 1st electronic expansion valve 104 as 1st expansion device, the indoor heat exchanger 105 as an evaporator, and an accumulator 108 in this order. Outdoor side connection edge 110b of the heat exchanger 110 for accumulation as a heat exchanger for supercooling and interior-of-a-room side connection edge 110c are connected to juxtaposition at the 2nd electronic expansion valve 112. In the heat storage tank 109 which filled the water W as an accumulation medium, the heat exchanger 110 for accumulation prepares cooling pipe 10a which moves in a zigzag direction in the direction of a vertical, and is formed. The 1st closing motion valve 111 is inserted in piping between the body 109 of the heat exchanger 110 for accumulation, and outdoor side connection edge 110b. A short circuit 113 branches from between the body 109 of the heat exchanger 110 for accumulation, and the 1st closing motion valves 111, and joins the main circuit 106 near the inlet port of an accumulator 8. The 2nd closing motion valve 114 is inserted in this short circuit 113. The opening of closing motion of the 1st closing motion valve 111 and the 2nd closing motion valve 114, the 1st electronic expansion valve 104, and the 2nd electronic expansion valve 112 is controlled by the closing motion control means 116 according to the signal from the operational status of this air conditioner and each thermistors Th1 and Th2, and a pressure sensor Ps.

[0025] At the time of accumulation operation, while the closing motion control means 116 changes [the 1st closing motion valve 111] an open condition and the 1st electronic expansion valve 104 into a close-by-pass-bulb-completely condition for a closed state and the 2nd closing motion valve 114, the opening of the 2nd electronic expansion valve 112 is controlled by it according to the signal from a thermistor Th 1 and a pressure sensor Ps. this -- the time -- a compressor -- 102 -- from -- breathing out -- having had -- a refrigerant (the arrow head of a continuous line shows the flow direction in drawing 8) -- an outdoor heat exchanger -- 103 -- condensing -- having -- a receiver -- 107 -- the -- two -- an electron -- an expansion valve -- 112 -- a passage -- accumulation -- ** -- a heat exchanger -- 110 -- setting -- the above -- water -- W -- heat exchange -- evaporating -- having had -- after -- a short circuit -- 113 -- the -- two -- closing motion -- a valve -- 114 -- a passage -- a main circuit -- 106 -- an accumulator -- eight -- letting it pass -- a compressor -- two -- absorbing -- having . It is cooled by heat exchange with the refrigerant which passes along cooling pipe 110a, and the water W in a heat storage tank 109 adheres to the front face of cooling pipe 110a as ice. Thereby, cold energy is stored in a heat storage tank 109.

[0026] At the time of air conditioning operation which performs accumulation recovery, the opening of a closed state, the 1st electronic expansion valve 104, and the 2nd electronic expansion valve 112 is controlled [the 1st closing motion valve 111] for an open condition and the 2nd closing motion valve 114 by the closing motion control means 116 according to the signal from a thermistor Th 2 and a pressure sensor Ps. At this time, the refrigerant (the arrow head of a broken line shows the flow direction in drawing 8) breathed out from the compressor 102 is condensed by the outdoor heat exchanger 103, and passes along a receiver 107. then, some refrigerants -- the 2nd electronic expansion valve 112 -- a passage -- as it is -- juncture 110c -- reaching -- although -- the remaining refrigerants -- branch point 110b to the 1st closing motion valve 111 -- a passage -- the object for accumulation -- after heat exchange with the ice generated in heat exchanger 110 at the time of accumulation operation supercools, juncture 110c is reached. At this time, the flow rate of the refrigerant which passes along the 2nd electronic expansion valve 112, and the refrigerant which passes along the heat exchanger 110 for accumulation becomes settled by the opening of the 2nd electronic expansion valve 112. Since the heat exchanger 110 for accumulation supercools the above-mentioned refrigerant using the cold energy stored in ice, it can supercool effectively the refrigerant which passes along cooling pipe 110a. After the refrigerant which joined by juncture 110c is decompressed by the 1st electronic expansion valve 104, it evaporates by heat exchange with indoor air in indoor heat exchanger 105, and is absorbed by the compressor 2 through an accumulator 8.

[0027] Thus, by supercooling a refrigerant by the heat exchanger 110 for accumulation, a refrigerating effect can be increased as compared with the case where supercooling is not performed. And it sets in Ph diagram shown in drawing 2 since the boiling points of the refrigerant which constitutes the non-azeotropy mixing refrigerant which flows into indoor heat exchanger 105 differed mutually, and is inclination (inclination to a specific-enthalpy shaft.) to the constant-temperature line in a two phase region (wet steam range). It is called a "temperature gradient" below. It is generated. For the temperature gradient of this two phase region, the inlet temperature of indoor heat exchanger 105 falls as compared with the case where a single refrigerant is used. Therefore, by indoor heat exchanger 105, the temperature gradient between the indoor air by which endoergic is carried out, and the refrigerant passing through the inside of the indoor heat exchanger 105 becomes large, and the heat exchange capacity of indoor heat exchanger 105 increases. Consequently, the refrigerating capacity improvement effect by supercooling can be further raised by heat exchange capacity increase of indoor heat exchanger 105 as compared with the case where a single refrigerant is used.

[0028] In addition, what is necessary is to change the 1st closing motion valve 111 and the 2nd closing motion valve 114 into a closed state, to change the 2nd electronic expansion valve 112 into a full open condition, and just to control the opening of the 1st electronic expansion valve 104 by the closing motion control means 116 according to the signal from a thermistor Th 2 and a pressure sensor Ps, in order to perform the usual air conditioning operation which does not perform accumulation recovery. At this time, the refrigerant breathed out from the compressor 102 is condensed by the outdoor heat exchanger 103, passes along a receiver 107 and the 2nd electronic expansion valve 112, evaporates by indoor heat exchanger 105, and is absorbed by the compressor 102 through an accumulator 108.

[0029] (The 3rd operation gestalt) Drawing 9 shows the air conditioner of another operation gestalt equipped with the refrigerant circuit which supercools a refrigerant using the cold energy supplied from another refrigerant circuit.

[0030] This air conditioner is equipped with two sets of two sets of one set [of an outdoor unit] A containing two equipments H and I of the same configuration, and the indoor units B and C connected to one equipment H of this outdoor unit A, and the indoor units D and E connected to the equipment I of another side of indoor unit A.

[0031] One equipment H of outdoor unit A connects the expansion device 204 for heating operation connected to juxtaposition to an accumulator 208, the compressor 201 driven with an inverter 207, the 4 way change-over valve 202, an outdoor heat exchanger 203, the heat exchanger 225 for supercooling, the check valve 209 that makes only an one direction (sense shown by the arrow head of a continuous line all over drawing) pass a refrigerant at the time of air conditioning operation, and this check valve 209 for the refrigerant piping 205. Similarly, the equipment I of another side connects the expansion device 204 for heating operation connected to juxtaposition to an accumulator 208, the compressor 201 driven with an inverter 207, the 4 way change-over valve 202, an outdoor heat exchanger 203, heat exchanger 225B for supercooling, the check valve 209 that makes only an one direction pass a refrigerant at the time of air conditioning operation, and this check valve 209 for the refrigerant piping 205. Each indoor units B, C, D, and E are the same internal configurations, and connect the expansion device 211 for air conditioning operation connected to juxtaposition to indoor heat exchanger 210, the check valve 213 to which the time of air conditioning operation makes only hard flow pass a refrigerant at the time of heating operation, and this check valve 213 for the refrigerant piping 212, respectively. In addition, below, air conditioning operation shall be explained.

[0032] The indoor units B and C of each other being connected to juxtaposition for the refrigerant piping 215,215, other refrigerant piping 216,216 connects with one equipment H of outdoor unit A possible [circulation of a refrigerant], and one refrigerant circuit 217 is formed. Similarly, the indoor units C and D of each other being connected to juxtaposition for the refrigerant piping 218,218, other refrigerant piping 219,219 connects with the equipment I of another side of outdoor unit A possible [circulation of a refrigerant], and another refrigerant circuit 220 is formed. The pressure sensor 235,236 for detecting the operational status of the refrigerant circuit, respectively is formed in the inlet side (the near refrigerant inlet port of outdoor unit A) of the compressor 201 of each refrigerant circuit 217,220.

[0033] As a refrigerant made to circulate through these refrigerant circuits 217,220, the non-azeotropy mixing refrigerant which consists of R-32/134a or R-407C is used.

[0034] Bypass circuit 230,230B is prepared between the refrigerant circuit 217 by the side of Equipment H, and the refrigerant circuit 220 by the side of Equipment I. the bypass circuit 230 (it has the refrigerant piping 227,228) -- from the downstream (an outlet near [at the time of air conditioning operation]) of the outdoor heat exchanger 203 of a refrigerant circuit 220 -- branching -- the closing motion valve 231, the expansion device 226, and the heat exchanger 225 for supercooling of a refrigerant circuit 217 -- a passage -- a refrigerant circuit 220 -- the refrigerant circuit 220 is joined near the inlet port of an accumulator 208. bypass circuit 230B (it has the refrigerant piping 227B and 228B) -- from the downstream (an outlet near [at the time of air conditioning operation]) of the outdoor heat exchanger 203 of a refrigerant circuit 217 -- branching -- closing motion valve 231B, expansion device 226B, and heat exchanger 225B for supercooling of a refrigerant circuit 220 -- a passage -- a refrigerant circuit 217 -- the refrigerant circuit 217 is joined near the inlet port of an accumulator 208. It is constituted like the double pipe exchanger 10 shown in drawing 4 (a), and the heat exchanger 225 for supercooling performs heat exchange between the mainstream refrigerant which flows a refrigerant circuit 217, and the bypass style refrigerant which flows the bypass circuit 230 which branched from the refrigerant circuit 220. On the other hand, supercooling heat exchanger 225B performs heat exchange between the mainstream refrigerant which flows a refrigerant circuit 220, and the bypass style refrigerant which flows bypass circuit 230B which branched from the refrigerant circuit 217.

[0035] The closing motion valves 231 and 231B of bypass circuit 230,230B are made a closed state by the control means which is not illustrated at the time of the usual air conditioning operation which does not

perform supercooling. At this time, a refrigerant circuit 217 and a refrigerant circuit 220 perform air conditioning operation mutually-independent. For example, the refrigerant (the arrow head of a continuous line shows the flow direction in drawing 9) breathed out from the compressor 201 in the refrigerant circuit 220 is ***** about heat exchanger 225B in the condition of the outdoor heat exchanger 203 which works as a condenser condensing, and not performing heat exchange, and a check valve 209. Then, the expansion device 211 of each indoor units B and C decompresses, and it evaporates by the indoor heat exchanger 210 which works as an evaporator, and a compressor 201 absorbs through the accumulator 208 of outdoor unit A. This is the same also in a refrigerant circuit 217.

[0036] While the refrigerant circuit 217,220 is performing air conditioning operation independently, based on the output of a pressure sensor 235,236, a complementary gets down by the refrigerant circuit 217 side, and cold energy presupposes that it was judged that cold energy ran short by the refrigerant circuit 220 side. According to this decision result, by the control means, closed state and closing motion valve 231B is set as an open condition, and the closing motion valve 231 shifts to air conditioning operation to which a refrigerant circuit 220 carries out supercooling. At this time, some refrigerants which flow a refrigerant circuit 217 branch, and bypass circuit 230B is flowed as a bypass style refrigerant (the arrow head of a broken line shows the flow direction in drawing 9). Consequently, heat-exchanger 225B for supercooling performs heat exchange between the mainstream refrigerant which flows a refrigerant circuit 220, and the bypass style refrigerant which flows the bypass circuit 230. That is, in a refrigerant circuit 220, the refrigerant breathed out from the compressor 201 is condensed by the outdoor heat exchanger 203 which works as a condenser, and is supercooled by the heat exchanger 225. And it passes along a check valve 209. Then, the expansion device 211 of each indoor units B and C decompresses, and it evaporates by the indoor heat exchanger 210 which works as an evaporator, and a compressor 201 absorbs through the accumulator 208 of outdoor unit A.

[0037] Thus, by supercooling a refrigerant by heat exchanger 225B, a refrigerating effect can be increased as compared with the case where supercooling is not performed. And it sets in Ph diagram shown in drawing 2 since the boiling points of the refrigerant which constitutes the non-azeotropy mixing refrigerant which flows into indoor heat exchanger 210 differed mutually, and is inclination (inclination to a specific-enthalpy shaft.) to the constant-temperature line in a two phase region (wet steam range). It is called a "temperature gradient" below. It is generated. For the temperature gradient of this two phase region, the inlet temperature of indoor heat exchanger 210 falls as compared with the case where a single refrigerant is used. Therefore, by indoor heat exchanger 210, the temperature gradient between the indoor air by which endoergic is carried out, and the refrigerant passing through the inside of the indoor heat exchanger 210 becomes large, and the heat exchange capacity of indoor heat exchanger 210 increases. Consequently, the refrigerating capacity improvement effect by supercooling can be further raised by heat exchange capacity increase of indoor heat exchanger 210 as compared with the case where a single refrigerant is used.

[0038] In addition, while the refrigerant circuit 217,220 is performing air conditioning operation independently When it is judged that cold energy gets down from a complementary by the refrigerant circuit 220 side contrary to the upper case, and cold energy runs short by the refrigerant circuit 217 side based on the output of a pressure sensor 235,236 According to this decision result, by the control means, open condition and closing motion valve 231B is set as a closed state, and the closing motion valve 231 shifts to air conditioning operation to which a refrigerant circuit 217 carries out supercooling.

[0039]

[Effect of the Invention] As mentioned above, according to the air conditioner according to claim 1 to 3, as compared with the former, refrigerating capacity can be further raised so that clearly.

[Translation done.]

* NOTICES *

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the configuration of the refrigerant circuit of the air conditioner of the 1st operation gestalt of this invention.

[Drawing 2] It is Ph diagram showing the refrigerating cycle by the refrigerant circuit of drawing 1 .

[Drawing 3] It is drawing explaining the heat exchange capacity of the evaporator in the refrigerant circuit of drawing 1 .

[Drawing 4] Drawing in which (a) shows the configuration of the double pipe exchanger of the refrigerant circuit of drawing 1 , drawing where (b) explains the coolant temperature in a counterflow mold heat exchanger, and (c) are drawings explaining the coolant temperature in a parallel-current-flow mold heat exchanger.

[Drawing 5] It is drawing showing the configuration of the refrigerant circuit which uses a double pipe exchanger as a mind-solution temperature exchanger for the comparison with the refrigerant circuit of drawing 1 .

[Drawing 6] It is Ph diagram showing the refrigerating cycle by the refrigerant circuit of drawing 5 .

[Drawing 7] It is drawing measuring and showing the refrigerating cycle by the refrigerant circuit of drawing 1 , and the refrigerating cycle by the refrigerant circuit of drawing 5 .

[Drawing 8] It is drawing showing the configuration of the refrigerant circuit of the air conditioner of the 2nd operation gestalt of this invention.

[Drawing 9] It is drawing showing the configuration of the refrigerant circuit of the air conditioner of the 3rd operation gestalt of this invention.

[Drawing 10] It is drawing showing the configuration of the refrigerant circuit of the conventional air conditioner.

[Drawing 11] They are Ph diagram showing the usual refrigerating cycle to which (a) does not perform supercooling, Ph diagram showing the refrigerating cycle according [(b)] to the refrigerant circuit of drawing 11 , and drawing which (c) expands the refrigerating cycle of (b) partially and is shown.

[Description of Notations]

2,102,201 Compressor

3 Condenser

5 Evaporator

10 Double Pipe Exchanger

103,203 Outdoor heat exchanger

105,210 Indoor heat exchanger

110 Heat Exchanger for Accumulation

225,225B Heat exchanger for supercooling

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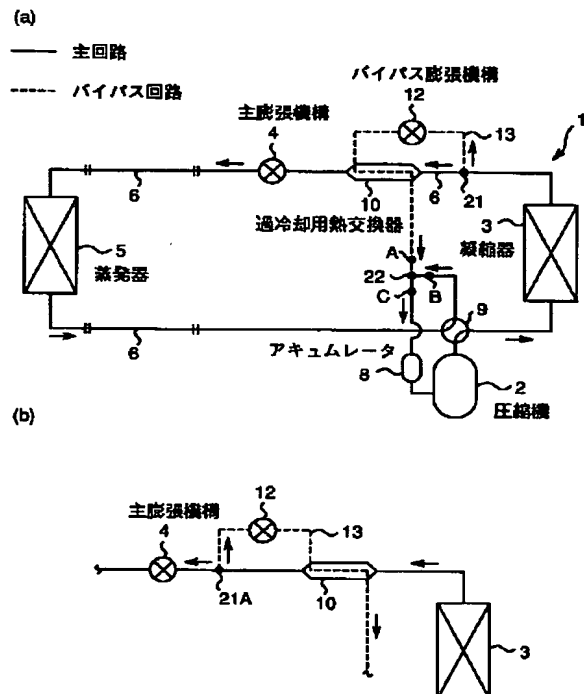
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(54) 【発明の名称】 空気調和機

(57) 【要約】

【課題】 従来よりも冷凍能力を向上できる空気調和機を提供する。

【解決手段】 圧縮機2、凝縮器3、過冷却用熱交換器10、第1の膨張機構4および蒸発器5の順に冷媒が流れる冷媒回路1を備える。冷媒として非共沸混合冷媒を用いる。冷媒回路1は、凝縮器3と第1の膨張機構4との間で主回路6から分岐して、圧縮機2の吸入側で主回路6と合流するバイパス回路13を備えるとともに、このバイパス回路13に第2の膨張機構12を有する。過冷却用熱交換器10は、主回路6を流れる主流冷媒と、第2の膨張機構12通過後のバイパス回路13を流れるバイパス流冷媒との間で熱交換を行う。過冷却用熱交換器10は、上記主流冷媒と上記バイパス流冷媒とが伝熱性を持つ壁10aを挟んで互いに反対向きに流れる対向流型熱交換器である。



【特許請求の範囲】

【請求項1】 圧縮機(2)、凝縮器(3)、過冷却用熱交換器(10)、第1の膨張機構(4)および蒸発器(5)の順に冷媒が流れる冷媒回路(1)を備えた空気調和機において、

上記冷媒として非共沸混合冷媒を用い、

上記冷媒回路(1)は、上記凝縮器(3)と第1の膨張機構(4)との間で主回路(6)から分岐して、上記圧縮機(2)の吸入側で上記主回路(6)と合流するバイパス回路(13)を備えるとともに、このバイパス回路(13)に第2の膨張機構(12)を有し、

上記過冷却用熱交換器(10)は、上記主回路(6)を流れる主流冷媒と、上記第2の膨張機構(12)通過後の上記バイパス回路(13)を流れるバイパス流冷媒との間で熱交換を行い、

上記過冷却用熱交換器(10)は、上記主流冷媒と上記バイパス流冷媒とが伝熱性を持つ壁(10a)を挟んで互いに反対向きに流れる対向流型熱交換器であることを特徴とする空気調和機。

【請求項2】 請求項1に記載の空気調和機において、上記バイパス回路(13)は、上記凝縮器(3)と過冷却用熱交換器(10)との間で上記主回路(6)から分岐していることを特徴とする空気調和機。

【請求項3】 請求項1に記載の空気調和機において、上記バイパス回路(13)は、上記過冷却用熱交換器(10)と第1の膨張機構(4)との間で上記主回路(6)から分岐していることを特徴とする空気調和機。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】この発明は空気調和機に関する。より詳しくは、圧縮機、凝縮器、冷媒を過冷却する過冷却用熱交換器、膨張機構および蒸発器の順に冷媒を循環させる冷媒回路を備えた空気調和機に関する。

【0002】

【従来の技術】図10に示すように、この種の空気調和機の冷媒回路301としては、圧縮機302、凝縮器303、過冷却用の二重管式熱交換器310、主膨張機構304、蒸発器305、四路切換弁309およびアキュムレータ308をこの順に有する主回路306と、上記凝縮器303と二重管式熱交換器310との間の分岐点321で主回路306から分岐して、バイパス膨張機構312と二重管式熱交換器310とを通り、上記アキュムレータ308の入口近傍の合流点322で主回路306と合流するバイパス回路(破線で示す)313を含むものが知られている。従来は、冷媒としてHCFC(ハイドロクロロフルオロカーボン)22等の単一冷媒が用いられている。圧縮機302から吐出された冷媒は、凝縮器(例えば室外空気に放熱する)303によって凝縮され、分岐点321で主回路306を流れる主流冷媒とバイパス回路313を流れるバイパス流冷媒とに

別れる。この主流冷媒は、二重管式熱交換器310において、バイパス膨張機構312通過後の上記バイパス流冷媒との熱交換によって過冷却された後、主膨張機構304によって減圧される。そして、主流冷媒は、蒸発器(例えば室内空気から吸熱する)305によって蒸発され、四路切換弁309および気液分離を行うアキュムレータ308を通して圧縮機302に吸い込まれる。一方、バイパス流冷媒は、上記バイパス膨張機構312を通過して減圧された後、二重管式熱交換器310において主流冷媒との熱交換によって蒸発される。この後、バイパス流冷媒は、アキュムレータ308の入口近傍の合流点322で主流冷媒と合流する。

【0003】このように二重管式熱交換器310で主流冷媒を過冷却することにより、過冷却を行わない場合に比して主流冷媒による冷凍効果を増大できる。また、冷媒の流れからバイパス流を分岐させることによって主流冷媒の体積流量が減少するので、図11(b)の圧力-比エンタルピ線図(以下「Ph線図」という。)に示すように、蒸発器305内および圧縮機302の吸入側配管での圧力損失 ΔP を減少させることができる(比較のため、過冷却を行わない場合の圧力損失 ΔP_0 を図11(a)に示している。)。したがって、システムの冷凍能力を向上させることができる。なお、図11(b)中にA、B、Cで示す箇所は、図10の冷媒回路301における合流点322近傍の点A、B、Cの状態に対応している。図11(b)を部分的に拡大して示す図11(c)によって良く分かるように、点Aに達したバイパス流冷媒と点Bに達した主流冷媒とが合流して、点Cの状態が得られる。

【0004】

【発明が解決しようとする課題】ところで、空気調和機の冷凍能力は常に向上させることが求められており、冷凍能力アップの要求に際限はない。

【0005】そこで、この発明の目的は、従来よりもさらに冷凍能力を向上させることができる空気調和機を提供することにある。

【0006】

【課題を解決するための手段】上記目的を達成するため、請求項1に記載の空気調和機は、圧縮機、凝縮器、過冷却用熱交換器、第1の膨張機構および蒸発器の順に冷媒が流れる冷媒回路を備えた空気調和機において、上記冷媒として非共沸混合冷媒を用い、上記冷媒回路は、上記凝縮器と第1の膨張機構との間で主回路から分岐して、上記圧縮機の吸入側で上記主回路と合流するバイパス回路を備えるとともに、このバイパス回路に第2の膨張機構を有し、上記過冷却用熱交換器は、上記主回路を流れる主流冷媒と、上記第2の膨張機構通過後の上記バイパス回路を流れるバイパス流冷媒との間で熱交換を行い、上記過冷却用熱交換器は、上記主流冷媒と上記バイパス流冷媒とが伝熱性を持つ壁を挟んで互いに反対向き

に流れる対向流型熱交換器であることを特徴とする。

【0007】この請求項1の空気調和機では、非共沸混合冷媒を構成する冷媒の沸点が互いに異なることから、冷媒の状態を表すP-h線図において、二相域（湿り蒸気範囲）で等温線に勾配（比エンタルピ軸に対する傾き。以下「温度勾配」という。）が生じる。この二相域の温度勾配のために、単一冷媒を用いる場合に比して、蒸発器の入口温度が低下する。したがって、蒸発器によって吸熱される流体（例えば室内空気）と、その蒸発器内を通る上記冷媒との間の温度差が大きくなって、蒸発器の熱交換能力が増大する。この結果、過冷却による冷凍能力改善効果は、単一冷媒を用いる場合に比して、上記蒸発器の熱交換能力増大分だけさらに向上する。

【0008】また、この空気調和機では、上記第2の膨張機構通過後のバイパス流冷媒を利用して、簡単な回路構成でもって主流冷媒を過冷却することができる。

【0009】さらに、この空気調和機では、上記過冷却用熱交換器は対向流型熱交換器であるから、過冷却用熱交換器の伝熱性を持つ壁の両側での、非共沸冷媒である主流冷媒とバイパス流冷媒との間の平均温度差が比較的大きくなる。例えば並行流型熱交換器の場合の平均温度差よりも大きくなる。この結果、過冷却用熱交換器の能力が向上する。

【0010】請求項2に記載の空気調和機は、請求項1に記載の空気調和機において、上記バイパス回路は、上記凝縮器と過冷却用熱交換器との間で上記主回路から分岐していることを特徴とする。

【0011】この請求項2の空気調和機では、過冷却用熱交換器によって過冷却される対象が主流冷媒だけとなるので、過冷却用熱交換器のサイズが比較的小さくて済む。

【0012】請求項3に記載の空気調和機は、請求項1に記載の空気調和機において、上記バイパス回路は、上記過冷却用熱交換器と第1の膨張機構との間で上記主回路から分岐していることを特徴とする。

【0013】この請求項3の空気調和機では、過冷却用熱交換器通過後に主流冷媒から分岐したバイパス流冷媒が第2の膨張機構に入るので、第2の膨張機構には二相流が入る可能性が少なくなる。したがって、第2の膨張機構はハンチングを起こすおそれがなく、安定に動作する。

【0014】

【発明の実施の形態】以下、この発明の実施の形態を詳細に説明する。

【0015】（第1実施形態）図1(a)に示すように、この発明の一実施形態の空気調和機は、主回路6とバイパス回路（破線で示す）13を含む冷媒回路1を備えている。冷媒回路1を循環させる冷媒としては、R-32/134aまたはR-407Cからなる非共沸混合冷媒を用いている。

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【0016】主回路6は、圧縮機2、凝縮器3、過冷却用熱交換器としての二重管式熱交換器10、第1の膨張機構としての主膨張機構4、蒸発器5、四路切換弁9およびアキュムレータ8をこの順に有している。バイパス回路13は、凝縮器3と二重管式熱交換器10との間の分岐点21で主回路6から分岐して、第2の膨張機構としてのバイパス膨張機構12と二重管式熱交換器10とを通り、アキュムレータ8の入口近傍の合流点22で主回路6と合流している。二重管式熱交換器10は、主回路6を流れる主流冷媒と、バイパス膨張機構12通過後の上記バイパス回路13を流れるバイパス流冷媒との間で熱交換を行う。つまり、バイパス膨張機構12通過後のバイパス流冷媒を利用して、簡単な回路構成でもって主流冷媒を過冷却するようになっている。詳しくは、二重管式熱交換器10は、図4(a)に模式的に示すように、内管10aと、この内管10aの外側に同心円状に設けられた外管10bとを有している。冷媒を流す向きは、内管10a内を流れるバイパス流冷媒と、内管10aと外管10bとの間の環状の隙間10cを流れる主流冷媒とが、伝熱性を持つ内管10aの管壁を挟んで互いに反対向きに流れるように設定されている（対向流型熱交換器）。このように熱交換器10を対向流型とした場合、図4(b)に示すように、伝熱性を持つ内管10aの管壁の両側での、主流冷媒とバイパス流冷媒との間の流れ方向に関する平均温度差が比較的大きくなる。例えば図4(c)に示す並行流型熱交換器の場合の平均温度差よりも大きくなる。この結果、熱交換器10の能力を向上させることができる。

【0017】さて、図1(a)に示す圧縮機2から吐出された冷媒は、凝縮器（例えば室外空気に放熱する）3によって凝縮され、分岐点21で主回路6を流れる主流冷媒とバイパス回路13を流れるバイパス流冷媒とに別れる。この主流冷媒は、熱交換器10において、バイパス膨張機構12通過後の上記バイパス流冷媒との熱交換によって過冷却された後、主膨張機構4によって減圧される。そして、主流冷媒は、蒸発器（例えば室内空気から吸熱する）5によって蒸発され、四路切換弁9および気液分離を行うアキュムレータ8を通して圧縮機2に吸い込まれる。一方、バイパス流冷媒は、バイパス膨張機構12を通過して減圧された後、熱交換器10において主流冷媒との熱交換によって蒸発される。この後、バイパス流冷媒は、アキュムレータ8の入口近傍の合流点22で主流冷媒と合流する。

【0018】このように熱交換器10で主流冷媒を過冷却することにより、過冷却を行わない場合に比して主流冷媒による冷凍効果を増大できる。また、冷媒の流れからバイパス流を分岐させることによって主流冷媒の体積流量が減少するので、過冷却を行わない場合（図1(a)参照）に比して、図2の圧力-比エンタルピ線図（以下「P-h線図」という。）に示すように、蒸発器5

内および圧縮機2の吸入側配管での圧力損失 ΔP を減少させることができる。したがって、システムの冷凍能力を向上させることができる。なお、図2中にA、B、Cで示す箇所は、図1(a)の冷媒回路1における合流点2近傍の点A、B、Cの状態に対応している。

【0019】しかも、冷媒回路1を流れる非共沸混合冷媒を構成する冷媒の沸点が互いに異なることから、図2に示すPh線図において、二相域（湿り蒸気範囲）で等温線に勾配（比エンタルピ軸に対する傾き。以下「温度勾配」という。）が生じる。この二相域の温度勾配のために、単一冷媒を用いる場合に比して、蒸発器5の入口温度が低下する。したがって、蒸発器5によって吸熱される流体（例えば蒸発器のフィンに接して通る室内空気）と、その蒸発器5内を通る冷媒との間の温度差が大きくなって、蒸発器5の熱交換能力が増大する。例えば図3に示すように、蒸発器5の入口温度が2degだけ低下すると、蒸発器5の熱交換能力が約15%増大する。この結果、過冷却による冷凍能力改善効果を、単一冷媒を用いる場合に比して、蒸発器5の熱交換能力増大分だけさらに向上させることができる。

【0020】また、図1(a)に示すように、バイパス回路13は凝縮器3と熱交換器10との間で主回路6から分岐しているため、熱交換器10によって過冷却される対象が主流冷媒だけとなる。したがって、熱交換器10のサイズを比較的小さくすることができる。

【0021】なお、バイパス回路13は、図1(b)に示すように、熱交換器10と主膨張機構4との間（分岐点21A）で主回路6から分岐するようにしても良い。このようにした場合、熱交換器10を通過後に主流冷媒から分岐したバイパス流冷媒がバイパス膨張機構12に入るので、バイパス膨張機構12には二相流が入る可能性が少なくなる。したがって、バイパス膨張機構12はハンチングを起こすおそれがなく、安定に動作する。

【0022】上述のように、熱交換器10は、凝縮器3によって凝縮された状態の、主回路6を流れる主流冷媒と、バイパス膨張機構12通過後のバイパス流冷媒との間で熱交換を行っている。すなわち、熱交換器10は、基本的には、凝縮器3通過後、蒸発器5通過前の主流冷媒とバイパス流冷媒との間で熱交換を行う液-液熱交換器として動作している。これに対して、図5に示すように、凝縮器5通過後の主流冷媒を過冷却するために、蒸発器5通過後（圧縮機吸入側）の気相の主流冷媒を用いて、熱交換器10を気-液熱交換器として動作させても良い。ただし、図1に示したような熱交換器10を液-液熱交換器として動作させる場合は、図7(a)のPh線図に示すように、二相域における温度勾配に起因して、熱交換器10における流れ方向に関する平均温度差 ΔT_m が、気-液熱交換器として動作させる場合の ΔT_m （図7(b)に示す）よりも大きくなる。したがって、熱交換器10のサイズを比較的小さくすることができ、圧

縮機2の吸入側の過熱度が大きくなるような不具合（図6参照）が生じない。この結果、非共沸混合冷媒を使用することによる冷凍能力改善効果をより有効に発揮することができる。

【0023】（第2実施形態）図8は、氷に蓄えられた冷熱を用いて冷媒を過冷却する冷媒回路101を備えた別の実施形態の空気調和機を示している。この冷媒回路101は、主回路106と短絡回路113とを含む冷媒回路101を備えている。冷媒回路101を循環させる冷媒としては、R-32/134aまたはR-407Cからなる非共沸混合冷媒を用いている。

【0024】主回路106は、圧縮機102、凝縮器としての室外熱交換器103、冷媒を一時貯留するためのレシーバ107、第2電子膨張弁112、第1の膨張機構としての第1電子膨張弁104、蒸発器としての室内熱交換器105、アキュムレータ108をこの順に有している。第2電子膨張弁112には並列に、過冷却用熱交換器としての蓄熱用熱交換器110の室外側連結端110b、室内側連結端110cが接続されている。蓄熱用熱交換器110は、蓄熱媒体としての水Wを満たした蓄熱槽109内に、鉛直方向に蛇行する冷却管10aを設けて形成されている。蓄熱用熱交換器110の本体109と室外側連結端110bとの間の配管には第1開閉弁111が介挿されている。短絡回路113は、蓄熱用熱交換器110の本体109と第1開閉弁111との間から分岐して、アキュムレータ8の入口近傍で主回路106と合流している。この短絡回路113には第2開閉弁114が介挿されている。第1開閉弁111および第2開閉弁114の開閉、第1電子膨張弁104および第2電子膨張弁112の開度は、この空気調和機の運転状態および各サーミスタTh1、Th2、圧力センサPsからの信号に応じて、開閉制御手段116によって制御されるようになっている。

【0025】蓄熱運転時には、開閉制御手段116によって、第1開閉弁111が閉状態、第2開閉弁114が開状態、第1電子膨張弁104が全閉状態にされるとともに、第2電子膨張弁112の開度がサーミスタTh1、圧力センサPsからの信号に応じて制御される。このとき、圧縮機102から吐出された冷媒（流れの向きを図8中に実線の矢印で示す）は、室外熱交換器103によって凝縮され、レシーバ107、第2電子膨張弁112を通り、蓄熱用熱交換器110において上記水Wとの熱交換によって蒸発された後、短絡回路113の第2開閉弁114を通り、主回路106のアキュムレータ8を通して圧縮機2に吸い込まれる。蓄熱槽109内の水Wは、冷却管110aを通る冷媒との熱交換によって冷却されて、冷却管110aの表面に氷として付着する。これにより、蓄熱槽109に冷熱が蓄えられる。

【0026】蓄熱回収を行う冷房運転時には、開閉制御手段116によって、第1開閉弁111が開状態、第2

開閉弁114が閉状態、第1電子膨張弁104および第2電子膨張弁112の開度がサーミスタTh2、圧力センサPsからの信号に応じて制御される。このとき、圧縮機102から吐出された冷媒（流れの向きを図8中に破線の矢印で示す）は、室外熱交換器103によって凝縮され、レシーバ107を通る。その後、冷媒の一部は第2電子膨張弁112を通り、そのまま合流点110cに達するが、残りの冷媒は、分岐点110bから第1開閉弁111を通り、蓄熱用熱交換器110において蓄熱運転時に生成された氷との熱交換によって過冷却された後、合流点110cに達する。このとき、第2電子膨張弁112を通る冷媒と蓄熱用熱交換器110を通る冷媒との流量比は第2電子膨張弁112の開度によって定まる。蓄熱用熱交換器110は、氷に蓄えられた冷熱を用いて上記冷媒を過冷却するので、冷却管110aを通る冷媒を効果的に過冷却することができる。合流点110cで合流した冷媒は、第1電子膨張弁104によって減圧された後、室内熱交換器105において室内空気との熱交換によって蒸発され、アキュムレータ8を通して圧縮機2に吸い込まれる。

【0027】このように蓄熱用熱交換器110で冷媒を過冷却することにより、過冷却を行わない場合に比して冷凍効果を増大できる。しかも、室内熱交換器105に流入する非共沸混合冷媒を構成する冷媒の沸点が互いに異なることから、図2に示したPh線図において、二相域（湿り蒸気範囲）で等温線に勾配（比エンタルピ軸に対する傾き。以下「温度勾配」という。）が生じる。この二相域の温度勾配のために、単一冷媒を用いる場合に比して、室内熱交換器105の入口温度が低下する。したがって、室内熱交換器105によって吸熱される室内空気と、その室内熱交換器105内を通る冷媒との間の温度差が大きくなって、室内熱交換器105の熱交換能力が増大する。この結果、過冷却による冷凍能力改善効果を、単一冷媒を用いる場合に比して、室内熱交換器105の熱交換能力増大分だけさらに向上させることができる。

【0028】なお、蓄熱回収を行わない通常の冷房運転を行うためには、開閉制御手段116によって、第1開閉弁111および第2開閉弁114を閉状態、第2電子膨張弁112を全開状態にし、第1電子膨張弁104の開度をサーミスタTh2、圧力センサPsからの信号に応じて制御すれば良い。このとき、圧縮機102から吐出された冷媒は、室外熱交換器103によって凝縮され、レシーバ107、第2電子膨張弁112を通り、室内熱交換器105によって蒸発され、アキュムレータ108を通して圧縮機102に吸い込まれる。

【0029】（第3実施形態）図9は、別の冷媒回路から供給される冷熱を用いて冷媒を過冷却する冷媒回路を備えた別の実施形態の空気調和機を示している。

【0030】この空気調和機は、同一構成の2つの機器

類H、Iを含む1台の室外ユニットAと、この室外ユニットAの一方の機器類Hに接続された2台の室内ユニットB、Cと、室内ユニットAの他方の機器類Iに接続された2台の室内ユニットD、Eを備えている。

【0031】室外ユニットAの一方の機器類Hは、アキュムレータ208と、インバータ207によって駆動される圧縮機201と、四路切換弁202と、室外熱交換器203と、過冷却用熱交換器225と、冷房運転時に冷媒を一方（図中に実線の矢印で示す向き）にのみ通過させる逆止弁209と、この逆止弁209に並列に接続された暖房運転用の膨張機構204とを冷媒配管205で接続したものである。同様に、他方の機器類Iは、アキュムレータ208と、インバータ207によって駆動される圧縮機201と、四路切換弁202と、室外熱交換器203と、過冷却用熱交換器225Bと、冷房運転時に冷媒を一方にのみ通過させる逆止弁209と、この逆止弁209に並列に接続された暖房運転用の膨張機構204とを冷媒配管205で接続したものである。各室内ユニットB、C、D、Eは同一内部構成であり、それぞれ室内熱交換器210と、暖房運転時に冷媒を冷房運転時とは逆方向にのみ通過させる逆止弁213と、この逆止弁213に並列に接続された冷房運転用の膨張機構211とを冷媒配管212で接続したものである。なお、以下では冷房運転に関して説明するものとする。

【0032】室内ユニットB、Cは冷媒配管215、215で互いに並列に接続されつつ、他の冷媒配管216、216により室外ユニットAの一方の機器類Hに冷媒の循環可能に接続されて一つの冷媒回路217が形成されている。同様に、室内ユニットC、Dは冷媒配管218、218で互いに並列に接続されつつ、他の冷媒配管219、219により室外ユニットAの他方の機器類Iに冷媒の循環可能に接続されて別の冷媒回路220が形成されている。各冷媒回路217、220の圧縮機201の吸入側（室外ユニットAの冷媒入口近傍）には、それぞれその冷媒回路の運転状態を検出するための圧力センサ235、236が設けられている。

【0033】これらの冷媒回路217、220を循環させる冷媒としては、R-32/134aまたはR-407Cからなる非共沸混合冷媒を用いている。

【0034】機器類H側の冷媒回路217と機器類I側の冷媒回路220との間には、バイパス回路230、230Bが設けられている。バイパス回路230（冷媒配管227、228を有する）は、冷媒回路220の室外熱交換器203の下流側（冷房運転時の出口近傍）から分岐して、開閉弁231、膨張機構226、冷媒回路217の過冷却用熱交換器225を通り、冷媒回路220のアキュムレータ208の入口近傍でその冷媒回路220と合流している。バイパス回路230B（冷媒配管227B、228Bを有する）は、冷媒回路217の室外熱交換器203の下流側（冷房運転時の出口近傍）から

分岐して、開閉弁231B、膨張機構226B、冷媒回路220の過冷却用熱交換器225Bを通り、冷媒回路217のアクムレータ208の入口近傍でその冷媒回路217と合流している。過冷却用熱交換器225は、例えば図4(a)に示した二重管式熱交換器10と同様に構成され、冷媒回路217を流れる主流冷媒と、冷媒回路220から分岐したバイパス回路230を流れるバイパス流冷媒との間で熱交換を行う。一方、過冷却熱交換器225Bは、冷媒回路220を流れる主流冷媒と、冷媒回路217から分岐したバイパス回路230Bを流れるバイパス流冷媒との間で熱交換を行う。

【0035】過冷却を行わない通常の冷房運転時には、図示しない制御手段によってバイパス回路230、230Bの開閉弁231および231Bが閉状態にされる。このとき、冷媒回路217と冷媒回路220とは互いに独立に冷房運転を行う。例えば冷媒回路220において、圧縮機201から吐出された冷媒（流れの向きを図9中に実線の矢印で示す）は、凝縮器として働く室外熱交換器203によって凝縮され、熱交換を行わない状態にある熱交換器225B、逆止弁209を通る。この後、各室内ユニットB、Cの膨張機構211によって減圧され、蒸発器として働く室内熱交換器210によって蒸発され、そして室外ユニットAのアクムレータ208を通して圧縮機201に吸い込まれる。これは冷媒回路217においても同様である。

【0036】冷媒回路217、220が独立に冷房運転を行っている時に、圧力センサ235、236の出力に基づいて、例えば冷媒回路217側で冷熱が余っており、冷媒回路220側で冷熱が不足していると判断されたとする。この判断結果に応じて、制御手段によって、開閉弁231が閉状態、開閉弁231Bが開状態に設定され、冷媒回路220が過冷却を行う冷房運転に移行する。このとき、冷媒回路217を流れる冷媒の一部が分岐して、バイパス流冷媒（流れの向きを図9中に破線の矢印で示す）としてバイパス回路230Bを流れる。この結果、過冷却用熱交換器225Bは、冷媒回路220を流れる主流冷媒と、バイパス回路230を流れるバイパス流冷媒との間で熱交換を行う。つまり、冷媒回路220において、圧縮機201から吐出された冷媒は、凝縮器として働く室外熱交換器203によって凝縮され、熱交換器225によって過冷却される。それから、逆止弁209を通る。この後、各室内ユニットB、Cの膨張機構211によって減圧され、蒸発器として働く室内熱交換器210によって蒸発され、そして室外ユニットAのアクムレータ208を通して圧縮機201に吸い込まれる。

【0037】このように熱交換器225Bで冷媒を過冷却することにより、過冷却を行わない場合に比して冷凍効果を増大できる。しかも、室内熱交換器210に流入する非共沸混合冷媒を構成する冷媒の沸点が互いに異な

ることから、図2に示したPh線図において、二相域（湿り蒸気範囲）で等温線に勾配（比エンタルピ軸に対する傾き。以下「温度勾配」という。）が生じる。この二相域の温度勾配のために、単一冷媒を用いる場合に比して、室内熱交換器210の入口温度が低下する。したがって、室内熱交換器210によって吸熱される室内空気と、その室内熱交換器210内を通る冷媒との間の温度差が大きくなって、室内熱交換器210の熱交換能力が増大する。この結果、過冷却による冷凍能力改善効果を、単一冷媒を用いる場合に比して、室内熱交換器210の熱交換能力増大分だけさらに向上させることができる。

【0038】なお、冷媒回路217、220が独立に冷房運転を行っている時に、圧力センサ235、236の出力に基づいて、上の場合とは逆に冷媒回路220側で冷熱が余っており、冷媒回路217側で冷熱が不足していると判断された場合は、この判断結果に応じて、制御手段によって、開閉弁231が開状態、開閉弁231Bが閉状態に設定され、冷媒回路217が過冷却を行う冷房運転に移行する。

【0039】

【発明の効果】以上より明らかなように、請求項1乃至3に記載の空気調和機によれば、従来に比してさらに冷凍能力を向上させることができる。

【図面の簡単な説明】

【図1】 この発明の第1実施形態の空気調和機の冷媒回路の構成を示す図である。

【図2】 図1の冷媒回路による冷凍サイクルを示すPh線図である。

【図3】 図1の冷媒回路における蒸発器の熱交換能力を説明する図である。

【図4】 (a)は図1の冷媒回路の二重管式熱交換器の構成を示す図、(b)は対向流型熱交換器における冷媒温度を説明する図、(c)は並行流型熱交換器における冷媒温度を説明する図である。

【図5】 図1の冷媒回路との比較のために、二重管式熱交換器を気-液熱交換器として用いる冷媒回路の構成を示す図である。

【図6】 図5の冷媒回路による冷凍サイクルを示すPh線図である。

【図7】 図1の冷媒回路による冷凍サイクルと図5の冷媒回路による冷凍サイクルとを比較して示す図である。

【図8】 この発明の第2実施形態の空気調和機の冷媒回路の構成を示す図である。

【図9】 この発明の第3実施形態の空気調和機の冷媒回路の構成を示す図である。

【図10】 従来の空気調和機の冷媒回路の構成を示す図である。

【図11】 (a)は過冷却を行わない通常の冷凍サイク

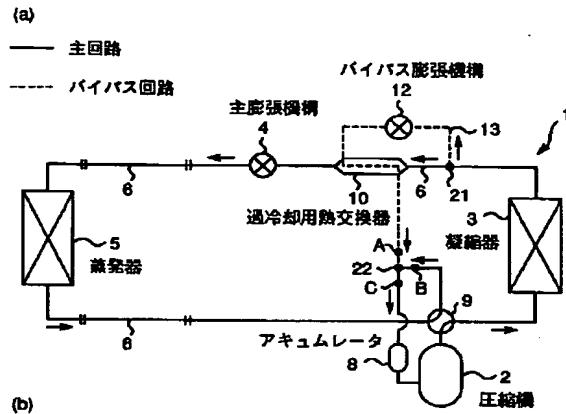
ルを示すP-h線図、(b)は図11の冷媒回路による冷凍サイクルを示すP-h線図、(c)は(b)の冷凍サイクルを部分的に拡大して示す図である。

【符号の説明】

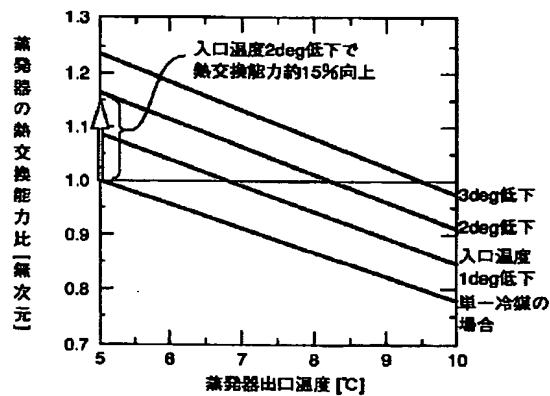
2, 102, 201 圧縮機

3 凝縮器

【図1】



【図3】



* 5 蒸発器

10 二重管式熱交換器

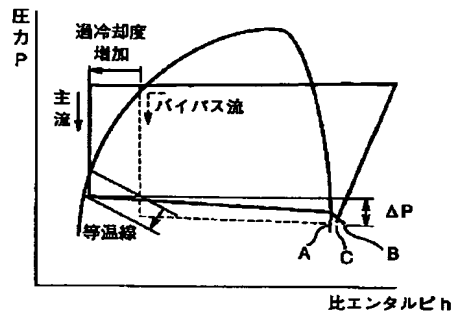
103, 203 室外熱交換器

105, 210 室内熱交換器

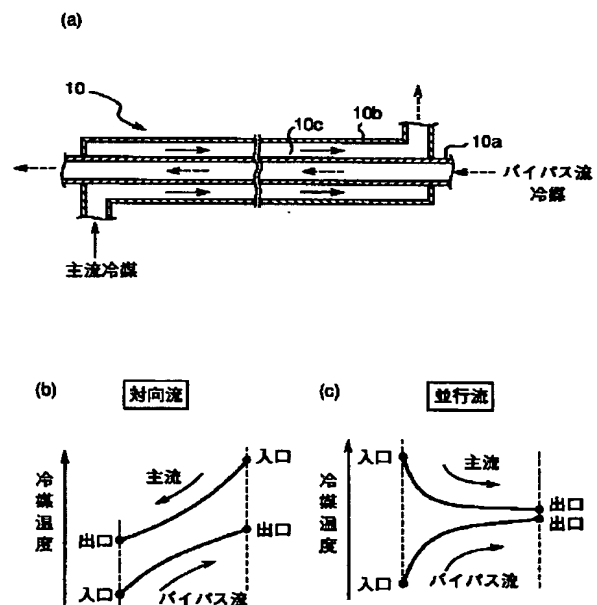
110 蓄熱用熱交換器

* 225, 225B 過冷却用熱交換器

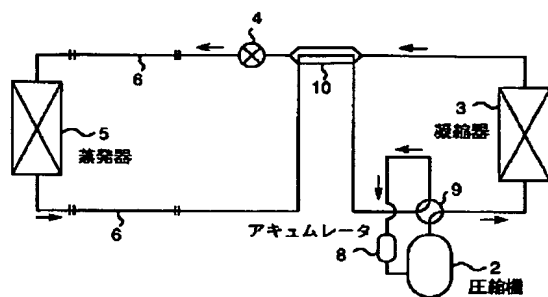
【図2】



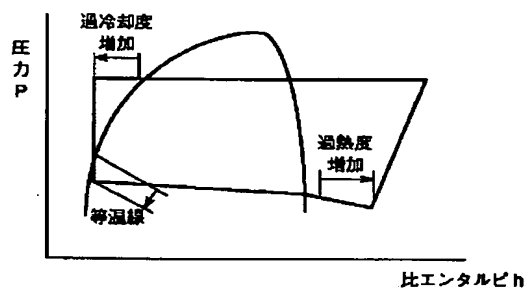
【図4】



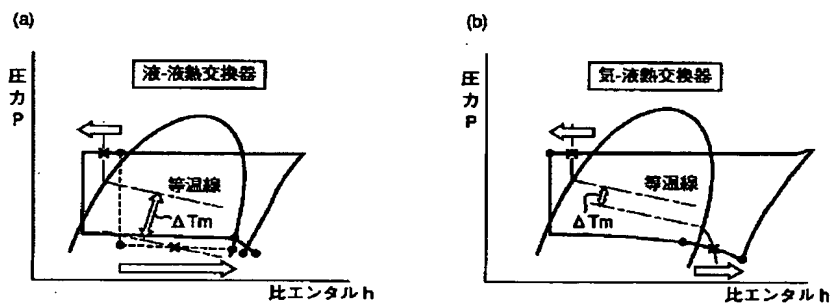
【図5】



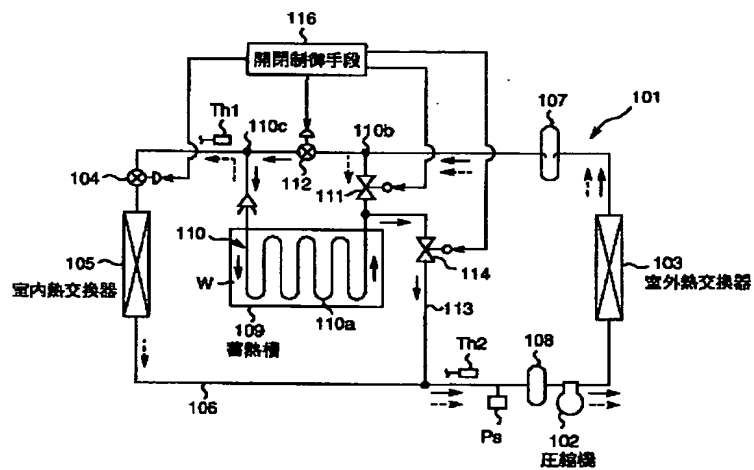
【図6】



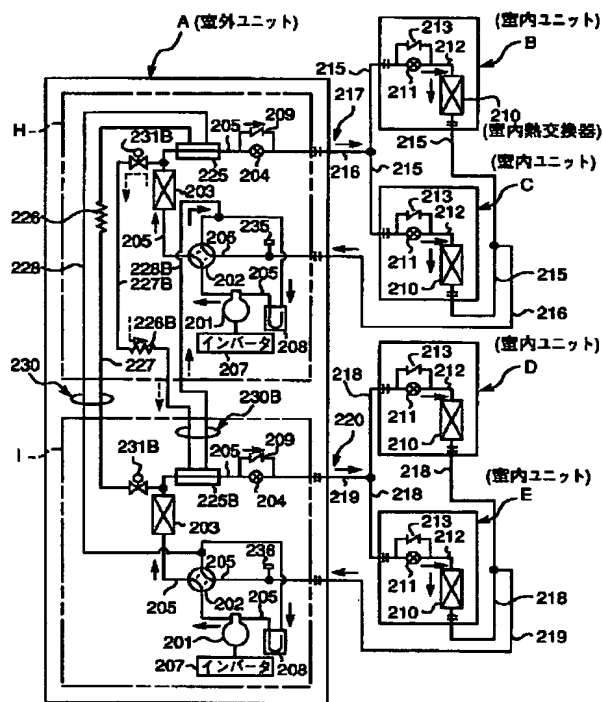
【図7】



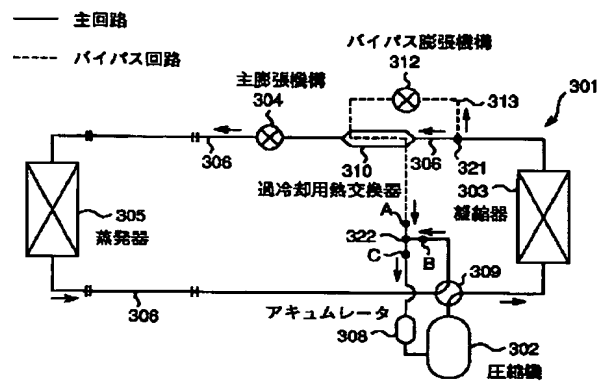
【図8】



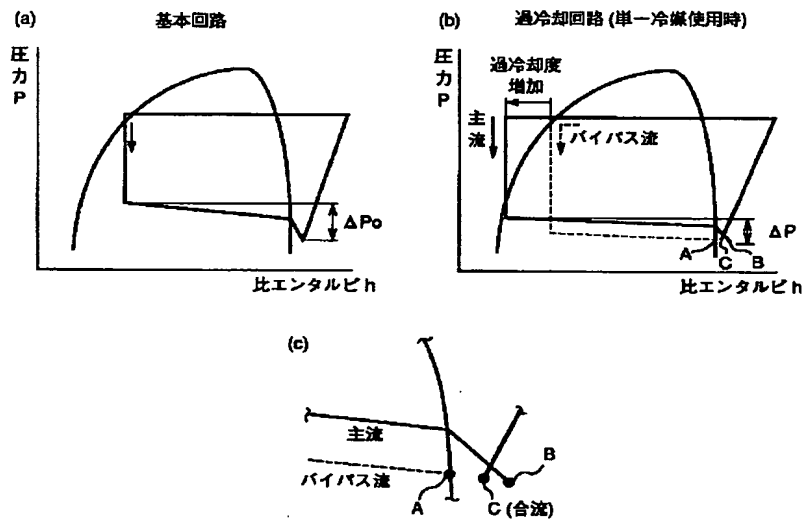
【図9】



【図10】



【図11】



フロントページの続き

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